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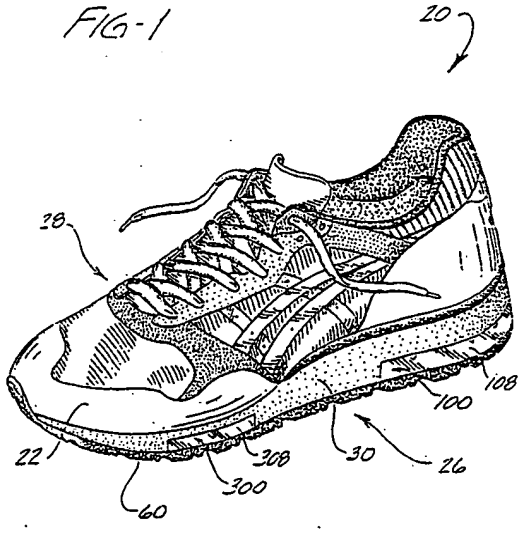
(54) A shoe.

(57) A shoe (20) comprising a sole portion (30,60) having peripheral edges and at least one cushioning element (100,200,300) comprising a chamber having flexible walls (106,108,206,208) filled with a liquid composition (110,210,310), wherein the chamber includes a plurality of partitions for directing flow of liquid (110,210,310) from one portion of the chamber to another portion of the chamber. Preferably, at least one partition is a gating means responsive to a differential in liquid pressure for enabling the flow of liquid to the chamber portion of lower liquid pressure. The cushioning element (110,200,300) overlays the sole portion (30,60). A portion of the cushioning element extends to a peripheral edge to provide cushioning support to a foot of a wearer at the peripheral edge. Preferably, the extending portion of the element (100,200,300) has substantially transparent walls (106,108,206,208) whereby the liquid composition can be viewed. Preferably, the liquid composition comprises an amount of a gel having a gel density and an amount of particulate density is less than the gel density. Preferably, the cushioning element (100,200,300) has a flexure joint (118) along a portion of the element, which is a partition for directing flow of liquid from one portion of the chamber to another portion of the chamber.

FIG-1



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The present invention relates to sports or athletic shoes, and in particular, to an athletic shoe constructed to minimize impact shock and to maximize lateral stability.

The modern shoe, particularly an athletic shoe, is a combination of many elements which have specific functions, all of which must work together for the support and protection of the foot. The design of an athletic shoe has become a highly refined science. Athletic shoes today are varied in both design and purpose. Tennis shoes, racquetball shoes, basketball shoes, running shoes, baseball shoes, football shoes, weightlifting shoes, walking shoes, wrestling shoes, etc., are all designed to be used in very specific, and very different, ways. They are also designed to provide a unique and specific combination of traction, support, and protection to enhance performance. Not only are shoes designed for specific sports, they are also designed to meet the specific characteristics of the user. For example, shoes are designed differently for heavier persons than for lighter persons; differently for wide feet than for narrow feet; differently for high arches than for low arches, etc. Some shoes are designed to correct physical problems, such as overpronation, while others include devices, such as ankle supports, to prevent physical problems from developing. It is therefore important to be able to adjust the characteristics of the various functional components of the shoe to accomodate these factors.

Generally, a shoe is divided into two parts, an upper and a sole. The upper is designed to snugly and comfortably enclose the foot. The sole is designed to withstand many miles of running. It must have an extremely durable bottom surface for contact with the ground. However, since such contact may be made with considerable force, protection of the foot and leg demands that the sole also perform a shock-absorbing function. It therefore typically includes a resilient, energy-absorbent material as a midsole in addition to the durable lower surface. This is particularly true for training or jogging shoes designed to be used over long distances and over a long period of time.

Extensive clinical evaluation of foot and knee injuries sustained by, for example, runners and joggers, suggests that the most important factors associated with such injuries are shock absorption on impact and lateral foot stability. Based on injury data, these two factors appear to be of about equal importance. Therefore, both factors should be carefully considered in any improvements in athletic shoes.

For most runners, initial foot impact occurs in the heel region. Therefore, the heel strike cushioning material, which is contained principally in the midsole of a running shoe must have a firmness which provides for proper impact cushioning for a person of about average weight. When the runner is heavy, the heel cushioning material may "bottom out" before heel impact is completely absorbed, and shock-related injuries can result. On the other hand, if the cushioning material is too soft, poor lateral foot stability may result in injuries. As a general rule, athletic shoes, for example running shoes, which have a relatively firm midsole, particular in the heel region, provide the best lateral stability.

Most sports include some running, though many sports place additional demands upon the shoe which are performance and/or injury related. Jump-land activities such as basketball, volleyball and aerobics typically produce forefoot impact forces due to initial forefoot contact followed shortly thereafter by greater rearfoot impact forces. These forces, either singularly, but more often cumulatively, can result in various lower extremity injuries. These activities also often incorporate mild to excessive side-to-side motions that require a stable foot platform, i.e., a stable shoe, for successful and injury free performance. These requirements are somewhat functionally similar to those of running but produce greater demands upon both the shoe and the lower extremities.

Shock to the foot, ankle, and leg maybe considered herein to be substantially vertically directed, and is directly proportional to the rate of vertical deceleration which the foot experiences during a football as well as a function the knee angle/action or the knee. In running, sequential impacting of first the lateral heel region in a foot, and thereafter the forefoot region, results in what might be thought of as a dual-peak shock-transmission situation. In other words, vertical foot deceleration tends to maximize in concurrence with these two events. Accordingly, shock absorption and reduction is directly attainable by minimizing the peaks of such peak deceleration by the use of a combination of heel strike, medial motion control, and forefoot cushioning elements. In landing from a jump the sequence occurs in reverse order.

These are many limiting factors in the design of a cushioned midsole for protection against foot and knee injuries, among them being the range of suitable cushioning materials. Current commercial cushioned midsoles comprise elastomeric foam, such as ethylene vinyl acetate (EVA) foam, within a narrow mid-range of hardness, or an elastomeric foam within which a gas-filled membrane is encapsulated. The use of elastomeric foam material by itself is limited to foams of relatively higher density and hardness, because low density and hardness foams are too soft and bottom out too quickly, i.e., collapse to a point where they no longer functions as a shock absorber under relatively low force, and also because low hardness foams provide very little lateral stability. Hence, prior art commercial midsoles have generally been limited to higher density, relatively hard foams, a compromise between cushioning and stability. The sue of a softer foam provides additional cushioning at a sacrifice to lateral stability. Conversely, the use of a har-

der foam enhances lateral stability at a sacrifice to cushioning.

The use of a cushioning system comprised of a membrane partitioned into a plurality of chambers which are filled with a gas, which in turn are incorporated into a foam midsole, improves the cushioning capability of the midsole over that of conventional EVA foam because it does not bottom out as rapidly; however, problems exist with respect to such cushioning systems, e.g. leakage, etc.

Additionally, gel filled cushioning elements are well known in the art. For example, U.S. Patent No. 4,768,295, to Ito, describes gel cushioning members having a plurality of chambers mounted in the recesses of sole plates. When the cushioning member is put in the recess formed in the sole plate, air chambers are formed between the filled chambers and the bottom of the recess. The air in the air chambers is compressed as the sole plate and the cushioning members are deformed by shock upon landing. The compressed air functions as a repulsion force when kicking. See also U.S. Design Patent Nos. 300,084 and 300,085 to Ito et al. and 297,381 to Sugiyama. Shoes containing such gel packs are sold by ASICS Tiger Corporation, Fountain Valley, California.

Additional prior art references relevant to this invention are:

U.S. Design Patent No. 297,980, to Sugiyama, describes a cushioning for a shoe midsole comprised essentially of one cell having partition walls therein.

U.S. Patent No. 3,765,422, to Smith, relates to a fluid cushion podiatric insole in the form of a flat envelope in the outline of the wearer's foot and containing a semi-liquid/solid particulate material as a flowing cushioning medium. The insole is provided with transverse dividers (ribs) which divide the insole into front and rear chambers, and longitudinal dividers which serve as flow-directing wall formations.

U.S. Patent No. 4,309,832, to Hunt, describes hinge joints in the sole of a shoe.

U.S. Patent Nos. 4,342,157 and 4,472,890, to Gilbert, describe the use of liquid-filled shock absorbing cushions in the heel portion and forefoot portion of a shoe. Typical liquids include water, glycerine, and mineral oil.

U.S. Patent No. 4,506,461; 4,523,393; and 4,322,892, to Inohara, describes a sports shoe sole wherein an interlayer body is provided at the heel portion with an air inclusion means such as grooves and apertures that open at least to one side of the interlayer body. The air inclusion portions open externally at each of the sides of the shoe.

U.S. Patent No. 4,535,553, to Derderian et al., discloses a shock-abosorbing sole member comprised of an insert member and elastomeric foam encasing the insert member. The insert member is formed of resilient plastic material and includes a plurality of transversely and longitudinally spaced discreet shock-absorbing projections.

U.S. Patent No. 4,567,677, to Zona, relates to a water and air filled shoe insole having flow restrictions so as to restrict the flow of water and air from the metatarsal area and heel area and vice versa. The flow restrictions are said to provide a massaging action for the foot of the user.

U.S. Patent No. 4,610,099, to Signori, describes a shock-absorbing shoe sole which provides adjustably inflated pneumatic support at the rear half of the sole by an inflatable bladder therein. A removable insole panel provides access for repair and/or replacement of the bladder. The bladder may have the upper and lower panel locally bonded or tufted at longitudinally and laterally spaced points to avoid the tendency to balloon when pressurized.

U.S. Patent No. 4,763,426, to Polus et al., describes a sports shoe with a sole which has air chambers which accept air at positive pressure and a foot operated pneumatic inflating device connected thereto.

U.S. Patent No. 4,815,221, to Diaz, describes a shoe having an energy control system for shock absorption and for propulsion of the wearer. The energy control system includes a spring system and an overlying energy absorbing member located in a cavity in the midsole.

U.S. Patent No. 4,817,304, to Parker et al., describes a sole member which includes a sealed inner member of a flexible material which is inflated with a gaseous medium to form a compliant and resilient insert. An elastomeric yieldable cuter member encapsulates the insert about preselected portions of the insert. On the sides is a gap, i.e., opening, which permits the insert to expand into the gap during foot impact. The shoe may be designed such that the sides of the insert are at least flush with and preferably extend beyond the sides of the shoes (see Fig. 4). Additional gaps may be provided in the forefoot aera.

U.S. Patent No. 4,833,795, to Diaz, describes a shoe having a pivot surface located in the ball portion of the forefoot region to facilitate pivoting as the foot contacts the ground. The pivot surface defines a cushioning air pocket between the outsole and the midsole.

U.S. Patent No. 4,856,208, to Zaccaro, describes a shoe sole which includes two inflatable tubes that extend along the sides of the body portion of the shoe or a single inflatable tube that extends around the periphery of the body portion so as to be define an elongated recess that exposes the bottom surface of the body portion, the fluid in the inflatable tubes moving therewithin when more load is applied on one side of the shoe defining use than the other.

U.S. Patent No. 4,887,367, to Mackness et al., describes the use of resilient spherical bodies within recesses in the front portion and/or the heel portion of the sole of a shoe. The hardness of the resilient

bodies can be adjusted to enhance the elasticity of the soles of the shoe by virtue of the fact that the spherical bodies can be inflated and deflated or can be replaced.

European Patent Application, Publication No. 0 298 449 to Litchfield, describes the midsole of a shoe having an elastomeric material which has a number of spaced apart horizontal tubes extending the width of the midsole which are encapsulated in the elastomeric material. The tubes are hollow and lay side-by-side in a direction either perpendicular to the longitudinal axis of the shoe, parallel to the axis, or in any other direction functional for foot and shoe mechanics. The tubes are preferably encapsulated by the polyurethane material including encapsulation of the end of the tubes to prevent easy collapse thereof.

Patents which illustrate visible cushion means include, for example, Yung-Mao (Nos. 4,843,741 and 4,974,345 and Swartz et al. (No. 4,972,611).

It is considered advantageous in the present invention to provide novel cushioning elements for an athletic shoe.

It is further considered advantageous to provide a shoe having gel cushioning elements which provide support at the peripheral edges of the shoe and which cushioning elements can be viewed from the exterior of the shoe.

It is a further considered advantageous to provide a shoe having gel cushioning elements therein which are transparent, wherein the coaction of the gel composition with the structure of the cushioning element can be viewed from the exterior of the shoe.

It is still further considered advantageous to provide an athletic shoe which includes a uniquely designed self-correcting or self-modulating gel cushioning system.

According to the present invention there is provided a shoe having a sole portion with peripheral edges and a cushioning element comprising a chamber having flexible walls filled with a liquid composition. The cushioning element overlies the sole portion and a portion of the cushioning element extends to a peripheral edge of the shoe to provide cushioning support to the foot of a wearer at the peripheral edge and to permit veiwing of the cushioning element from the exterior of the shoe. Preferably, the portion of the cushioning element that can be viewed has substantially transparent walls, wherein the coaction of the liquid composition with the structure of the element can be viewed therethrough.

This invention is further directed to a shoe comprising a sole portion having peripheral edges, a cushioning element comprising a chamber having flexible walls filled with a liquid composition, preferably a gel composition. The liquid composition preferably, comprises an amount of a gel having a gel density and an amount of particulate having a particulate density, wherein the particulate density is less than the gel density to provide a gel composition having an overall lower density than gel alone. The cushioning element overlies the sole portion, a portion of the element extending to a peripheral edge to provide cushioning support to the foot of a wearer, the extending portion of the element having substantially transparent walls, whereby the liquid composition can be viewed from the exterior of the shoe through the substantially transparent walls.

A preferred cushioning element is a heel strike cushioning element comprising a chamber having flexible walls filled with a gel composition, wherein the chamber includes a plurality of partitions for directing flow from one portion of the element to another portion of the element, wherein at least one partition is a gating means responsive to a differential in liquid pressure for enabling the flow of liquid to the portion of the element of lower liquid pressure. Preferably, the heel strike cushioning element has a flexure joint along a portion of the element, which is a partition that allows for the flexure of the element, assists in directing the flow of liquid from one portion of the element to another portion of the element and provides structural support for the cushioning element.

Still another aspect of this invention is directed to a cushioning element for a shoe sole comprising a chamber having flexible walls filled with a liquid composition, wherein the chamber includes a plurality of partitions for directing flow from one portion of the chamber to another, wherein at least one partition is a gating means responsive to a differential in liquid pressure for enabling the flow of liquid to the chamber portion of lower liquid pressure.

Another preferred cushioning element is a forefoot cushioning element for a shoe sole comprising a chamber having flexible substantially transparent walls filled with a liquid composition, wherein the chamber includes a plurality of partitions for directing flow from one portion of the chamber to another portion of the chamber, wherein the liquid composition comprises an amount of a gel having a gel density and an amount of particulate having a particulate density, wherein the particulate density is less than the gel density. Preferably the forefoot cushioning element has a flexure joint along a portion of the element which is a partition for directing flow of liquid from one portion of the chamber to another portion of the chamber.

Still another aspect of this invention is directed to a heel strike cushioning element for a shoe sole comprising a chamber having flexible substantially transparent walls filled with a liquid composition, wherein the chamber includes a plurality of partitions for directing flow from one portion of the chamber to another portion of the chamber, wherein at least one partition is a gating means responsive to a differential in liquid pressure for enabling the flow of liquid to the chamber portion of lower liquid pressure, wherein the liquid composition can be viewed through the substantially

transparent walls, wherein the liquid composition comprises an amount of a gel having a gel density and an amount of particulate having a particulate density, wherein the particulate density is less than the gel density, wherein the cushioning element has a flexure joint along a portion of the element which is a partition for directing flow of liquid from one portion of the chamber to another portion of the chamber.

The foregoing and other objects, features and advantages of this invention will be apparent from the following description of the preferred embodiments of the invention as illustrated in the accompanying drawings.

A preferred embodiment of the present invention will now be described in detail, by way of example only, with reference to the accompanying drawings, of which:

Figure 1 is a perspective view of an athletic shoe upper and the visible gel cushioning elements of this invention;

Figure 2 is an exploded perspective view of the shoe of Figure 1 depicting the various elements of this invention;

Figure 3 is a top plan view of the midsole of the shoe of this invention with the gel cushioning elements positioned in their respective cavities;

Figure 4 is a top plan view of the heel strike cushioning element of this invention;

Figure 5 is a bottom plan view of the heel strike cushioning element of this invention;

Figure 6 is a transverse cross-sectional view of the heel strike cushioning element of this invention taken along line **6-6** of **Figure 4**;

Figure 7 is a partial cross-sectional view of the heel strike cushioning element taken along line **7-7** of **Figure 4**;

Figure 8 depicts the heel cushion of **Figure 7** after impact;

Figure 9 is a partial longitudinal cross-sectional view of the heel strike cushioning element of this invention taken along line **9-9** of **Figure 4** after initial impact on the element by the heel occurs;

Figure 10 is a top plan view of the medial motion control cushioning element of this invention;

Figure 11 is a bottom plan view of the medial motion control cushioning element of this invention;

Figure 12 is a longitudinal cross-sectional view of the medial motion control cushioning element of this invention taken along line **12-12** of **Figure 10**;

Figure 13 is a transverse cross-sectional view of the medial motion control cushioning element of this invention taken along line **13-13** of **Figure 10**;

Figure 14 is a view similar to **Figure 12** showing initial compression at the proximal end of the medial motion control cushioning element;

Figure 15 is a top cross-sectional view of the medial motion control cushioning element taken along line **15-15** of **Figure 14**;

Figure 16 is a top plan view of the forefoot cushioning element of this invention;

Figure 17 is a partial cross-sectional view of a contouring ridge taken along line **17-17** of **Figure 16**;

Figure 18 is a partial cross-sectional view of a partition taken along line **18-18** of **Figure 16**;

Referring to the drawings, wherein like numerals indicate like elements, an article of footwear, such as an athletic shoe, sports shoe, or running shoe, is depicted in accordance with the present invention. Generally, the shoe comprises a sole structure or member and an upper attached thereto. The upper can be of any conventional design, while the sole structure incorporates the novel features of the present invention. The sole structure includes a force absorbing midsole and a flexible, wear resistant outsole. Of course, where appropriate, the midsole and outsole portions can be formed as a single integral unit. The midsole includes at least one cushioning element of this invention.

Referring to **Figure 1**, an athletic shoe, shown generally at 20, incorporates the cushioning elements of this invention. As used herein, the "lateral edge" refers to the outside peripheral edge of the shoe and the "medial edge" refers to the inside edge of the shoe. Further, as used herein, reference to the "distal end" refers to that end of the shoe near the toes, and reference to the "proximal end" refers to that end near the heel of the shoe. All components shown in the drawings are for a left shoe, the components for a right shoe being mirror images thereof. Further, it will also be noted that the various cushioning elements of this invention may be repositioned and/or used in various combinations, depending on the various activities for which the shoe is designed and/or targeted costs/selling prices.

As may be seen in **Figure 1**, shoe 20 has an upper 22 attached to midsole 30. Readily visible at the lateral edge 26 of the shoe 20 are two of the cushioning elements of this invention: heel strike cushioning element 100 and forefoot cushioning element 300. Referring to **Figures 2** and **3**, the third cushioning element of the present invention, medial motion cushioning element 200, is positioned at the medial side 28 of the shoe 20.

Referring to **Figure 2**, midsole 30, generally formed of a foam material, has proximal end 32, distal end 34, top surface 46, bottom surface 48 and a raised lip 52. Referring to **Figures 2, 4 and 5**, the heel strike cushioning element 100 comprises a chamber having a top surface 102, a bottom surface 104, an inner wall 106 and an outer lateral wall 108. Referring to **Figures 2, 10 and 11**, the medial motion control cushioning element 200 comprises a chamber having a top surface 202, bottom surface 204, proximal wall 207, distal wall 209, lateral wall 206 and medial wall

208. Referring to **Figures 2 and 16** the forefoot cushioning element 300 comprises a chamber having a top surface 302, bottom surface 304, medial wall 306, proximal wall 307, lateral wall 308 and distal wall 309. The walls of the chambers of all of the cushioning elements 100, 200 and 300 are preferably substantially-transparent or alternatively almots translucent. In the preferred embodiment, the walls are comprised of a flexible TPE material (thermoplastic elastomer), e.g. polyurethane. The chambers contain therein a liquid composition 110, 210 and 310. The location of the cushioning elements 100, 200 and 300 within the shoe 20 enables the elements to be viewed from the exterior of the shoe and the transparency of the walls permits the viewing of the coaction of the liquid composition with the interior of the cushioning element.

Still referring to **Figure 2**, the foam material of the midsole 30 preferably covers the upper surfaces of the cushioning elements 100, 200, and 200, as well as a major portion of the sides. Rubber outersole 60 has a proximal heel and 62, a distal toe end 64, lateral edge 72 top surface 66. Bottom 68 is formed into any suitable tread pattern.

After components 100, 200, and 300 are placed within respective cavities 36, 38, and 42 of midsole 30, rubber outersole 60 is bonded with adhesive to the bottom surface 48 of the midsole and the bottom surfaces, 104, 204, and 304 of cushioning elements 100, 200 and 300. Suitable means well known in the art, for example adhesive means, and/or anchoring devices, can be used to adhere or attached to cushioning element 100, 200, and 300 to midsole 30 prior to the bonding of the midsole 30 onto top surface 66 of outersole 60. Upper 22 is bonded onto top surface 46 of midsole 30 along lower edge 24 of upper 22. Again such techniques for attachment are well known in the art.

Figure 4 is a top view of heel strike cushioning element 100. The heel strike cushioning element 100 is positioned within midsole 30 such that its outer lateral wall 108 extends to the peripheral edge of the midsole 30 to provide the wearer with a wide cushioned support base at the heel of the shoe 20. Top surface 102 is in alignment with the heel of the wearer. Heel strike cushioning element 100 comprises a chamber defined by walls which are preferably substantially-transparent or transparent. Heel strike cushioning element 100 is divided into four regions or zones: first zone 124, second zone 126, third zone 128, and fourth zone 130. A series of staggered flexible partitions 116 are disposed in the fourth zone 130 and serve to modulate of direct the transfer or flow of the liquid composition 110, contained within the heel strike cushioning element 100, from one zone to another. See **Figure 9**. Some partitions 116 act to direct the flow of the liquid composition 110 while others function as a gating means, i.e., the passage of liquid thereby is permitted only upon the buildup of predetermined liquid pressures.

Liquid composition 110 is preferably comprised of a liquid gel 112 having particulate material 114 therein. Particulate 114 is preferably of a density less than the density of the gel 112 and serves to retard rapid transfer of the liquid composition 110 at it passes about partitions 116 and 188 (See **Figures 6** and **9**). Further, the lower density particulate 114 serves to decrease the weight of the liquid compositin 110.

As can be seen in **Figures 4, 5, 7** and **8**, an oval heel cushion 122 overlies first zone 124. Heel cushion 122 is comprised of an annular groove 111 extending from top surface 102 of the heel strike cushioning element 100 towards, but not touching, bottom surface 104. Upon impact, heel cushion 122 absorbs the force of the heel and the liquid composition 110 is gradually urged into adjacent second zone 126. At this point the heel cushion 122 in connection with flexure joint 118 (**see Figures 4 and 6**), becomes a supporting structural element. The overall force generated by the impact of the heel continues urging liquid composition 110 through second zone 126 into third and fourth zones 128 and 130.

Referring to **Figures 4 and 6**, the flexure joint 118 comprises flexible depending partitions. The flexure joint 118 overlies raised ridge channel 120 formed in the bottom 104 of the heel strike cushioning element 100. The raised ridge channel 120 follows the contour of the flexure joint 118. Upon full impact of the heel, the flexure joint 118 is depressed sufficiently such that the downward edge contacts ridge channel 120 and the side walls provide structural stability to heel strike cushioning element 100 (see **Figure 8**). Flexure joint 118 serves three primary functions: diversion of liquid composition 110, increased flexibility and structural support. Fourth zone 130 is configured to provide sufficient lateral stability and yet allow for the communication of the liquid composition 110 from one zone of the heel strike cushioning element 100 to another.

During use, localized forces acting in any zone of heel strike cushioning element 100 cause a series of responses in adjacent zones to constantly modulate and adjust the heel strike cushioning element 100 to the heel forces generated by the wearer. See **Figure 9** which depicts the initial impact of the heel of shoe 20 with the ground 400. Instead of a generic shock absorption associated with conventional shock absorption means, the components of this invention offer biomechanically correct placement and self-adjusting shock absorption characteristics throughout the full range of impact. Structural stability is enhanced by virtue of dual purpose partitions and supports 116 and 118 as well as heel cushion 122 and 111 (see **Figures 7** and **8**).

Figures 10-15 show medial motion cushioning element 200. Medial motion cushioning element 200 comprises a chamber defined with walls, preferably

substantially-transparent or transparent. It further comprises three regions or zones: proximal zone 234, central zone 236 and distal zone 238. Proximal zone 234 is adjacent to and defined by large flexible partition 216 and small flexible partition 218. Central zone 236 extends from partitions 216 and 218 to partitions 224 and 226, which are, respectively, large and small. Disposed within central zone 236 is a pair of flexible partitions 220 and 222. Adjacent distal zone 238, and separating it from central zone 236, is large flexible partition 224 and small flexible partition 226.

The medial motion cushioning element 200 contains a liquid composition 210 comprised, preferably, of a liquid gel 212 and a particulate material 214. The liquid composition 210 is preferably formualted similarly to, and likewise responds similarly to, the liquid composition 110 of heel strike cushioning element 100. It should be noted however that a liquid composition having different characteristics than that used in the heel strike cushioning element 100 may be used. Similarly, the wall structure of each element may be different, e.g. thickness, etc. The partitions within the medial motion cushioning element 200 act similarly to the partitions of the heel strike cushioning element 100 in that they serve to modulate the transfer of the liquid composition 210 from one zone of the medial motion cushioning element 200 to another.

Refering to **Figure 14**, after impact of the heel portion of shoe 20 with the ground 400, during the follow through of a stride, slight compression of medial motion cushioning element 200 occurs in proximal zone 234 and urges liquid composition 210 towards central zone 236 and distal zone 238. **Figure 15** shows the flow path of the gel as it is urged past the flexible partitions (216, 218, 220, 224, and 226), as well as between adjacent zones (234, 236 and 238).

Forefoot cushioning element 300 is shown in **Figures 16, 17** and **18**. The forefoot cushioning element 300 comprises a chamber defined by a top surface 302, a bottom surface 304, a medial outer wall 306, a proximal outer wall 307, a lateral outer wall 308 and a distal outer wall 309, the walls, in the preferred embodiment being substantially transparent or transparent. The forefoot cushioning element 300 contains a liquid composition 310 comprised, preferably, of a liquid gel 312 and a particulate material 314. The liquid composition 310 is preferably formulated similar to, and likewise responds similar to, the liquid composition 110 of heel strike cushioning element 100 and the liquid composition 210 of medial motion cushioning element 200, though it may be formulated differently.

Referring to **Figures 16 and 17**, a series of contour ridges, indicated generally at 316, are positioned along the periphery of forefoot cushioning element 300, at various locations therewithin. A contour ridge 316 is formed by adjacent channels 318 and 320 formed at corresponding positions on opposing surfaces 302 and 304 respectively. Contour ridges 316 allow forefoot cushioning element 300 to bend longitudinally and transversely.

Referring to **Figures 16 and 18**, also provided on the forefoot cushioning element 300, is a series of flexibel partitions 322 which depend downwardly into the cushioning element from the top surface 302. The flexible positions 322 coact with the contour ridges 316 to define various zones 324 within the forefoot cushioning element 300. The flexible portions 322 act in connection with the contour ridges 316 to modulate the flow of the liquid composition 310 between zones 324 during compression of forefoot cushioning element 300. The flexible partitions 322 also serve as support elements when full compression occurs in a given area. As such, the flexible partitions 322 function similar to the flexure joints 118 of the heel strike cushioning element 100. Upon full compression, the bottoms of the flexible partitions 322 contact the bottom surface 304 of forefoot cushioning element 300 and the sidewalls of the flexible partitions 322 support the top surface 302. Forefoot cushioning element 300 is preferably formed of polyurethane as a single piece.

It can be appreciated by those skilled in the art that with minor design alterations of any or a plurality of the design parameters, the cushioning elements of this invention can be readily adapted for a variety of footwear applications and for achievement of a variety of performance levels for the shoe.

This invention permits the cushioning elements of a shoe to be viewed from the exterior of a shoe. This is accomplished by the exterior of a portion of the cushioning elements 100, 200, and 300 extending to the periphery of the sole of the shoe. Further, because the walls of the cushioning elements 100, 200, and 300 are transparent, the inside of the cushioning element may be viewed. Conventional systems require the use of a window or opening in the midsole of the shoe to allow one to view the interior cushioning action. The cushioning elements 100, 200 and 300 of this invention, however, are preferably designed to be coplaner with the peripheral edge of the midsole thereby allowing full and unrestricted viewing into cushioning elements 100, 200 and 300 through the transparent structural sidewalls of the cushioning elements.

The force generated within the gel cushioning elements 100, 200, and 300 cause the deflection of the appropriate partitions and/or flexure joints which act as variable orifice gates which control the flow rate of the liquid composition 110, 210, and 310 as it moves forward in a dynamic "presupportive" manner in preparing the midsole to receive the vectorized forces. Some contour ridges actually separate the composite gel by blocking off the flow, i.e., controlling the flow rate, of the more solid particles of the composite gel sytem itself. The flexure joints also provide secondary structural support producing an overall support

system functionally sensitive to a greater range of forces. The partitions, contour ridges and flexure joints are transparent in the preferred embodiment to increase visibility within the cushioning elements to observe the dynamic composite gel.

The cushioning elements 100, 200 and 100 are filled with a liquid composition 110, 210 and 310, preferably a liquid gel 112, 212 and 312 or a combination of liquid gel 112, 212 and 312, e.g. silicon based, and a particulate material 114, 214 and 314. As a Preferred embodiment the gel and particulate includes a particulate material having a density lower than that of the gel to provide a lighter liquid composition than is obtainable with using only a gel composition. Preferably, the particulate material does not absorb the liquid. This results in a retardation of the liquid composition 110, 210 and 310 as it travels, and also produces a ball bearing effect within cushioning elements 110, 210 and 310. Additionally, the combination of gel and particulate, when used in a cushioning element having transparent walls, which extend to the periphery of the midsole, can be viewed from the exterior of the shoe to demonstrate the coaction of the gel and particulate with the unique dynamic structure of the interior of the cushioning element. Note that the gel composition may or may not be pressurized within the chamber of the cushioning elements.

The use of colored liquid compositions within the cushioning elements 100, 200 and 300 can enhance the visualization of the dynamic function. The particulate material 114, 214 and 314 in any or all of the cushioning elements 100, 200 and 300 can be of reflective type material or coating such as glitter, or can be of different color from the liquid composition 110, 210 and 310 itself thereby creating a multicolored effect. Additionally, the liquid composition may be of a iridescence color to enhance the visibility of both the shoe, and the wearer when jogging at night, etc.

The elastomeric foam materials from which the foam and encapsulating member can be made includes the following: polyether urethane; polyester urethane; ethylenevinylacetate/-polyethylene copolymer; polyester elastomer (Hytrel); nitrile rubber; ethylene propylene; polybutadiene; SBR (styrene-butadiene rubber); XNBR (carbocylated nitrile rubber).

The preferred system of this invention comprises a fully blow-molded midsole structure which forms a structural midsole edge and contains the visible dynamic, composite self-compensating, cushioning system of this invention. Upon initial "touchdown contact" of the athletic shoe at the outside lateral edge of the heel aspect, the forces generated cause a series of reactions within the composite gel medium which create unique and controllable flow patterns for different contact points.

While the invention has been described in its preferred embodiments, it is to be understood that the words which have been used are words of description rather than limitation and that changes may be made within the purview of the appended claims without departing from the true scope and spirit of the invention in its broader aspects.

Claims

1. A shoe comprising:
   a sole portion having peripheral edges;
   a cushioning element comprising a chamber having flexible walls filled with a liquid composition, the cushioning element overlying the sole portion, a portion of the element extending to a peripheral edge to provide cushioning support to a foot of a wearer at the peripheral edge, whereby the cushioning element can be viewed from the exterior of the shoe.

2. A shoe as claimed in Claim 1, characterised in that the extending portion of the element has substantially transparent walls whereby the liquid composition can be viewed from the exterior of the shoe.

3. A shoe comprising:
   a sole portion having peripheral edges;
   a cushioning element comprising a chamber having flexible walls filled with a liquid composition, wherein the liquid composition comprises an amount of a liquid having a liquid density and an amount of particulate having a particulate density, wherein the particulate density is less than the liquid density,
   wherein the cushioning element overlies the sole portion, a portion of the element extending to a peripheral edge to provide cushioning support to a foot of a water at the peripheral edge, the extending portion of the element having substantially transparent walls, whereby the liquid composition can be viewed from the exterior of the shoe through the substantially transparent walls.

4. The shoe of Claim 1,2 or 3, wherein the chamber includes a plurality of partitions for directing flow from one portion of the chamber to another portion of the chamber.

5. The shoe of Claim 4, wherein at least one partition is a gating means responsive to a differential in liquid pressure for enabling the flow of liquid to the chamber portion of lower liquid pressure.

6. The shoe of Claim 5, wherein the gating means is a flexible member extending from the chamber wall into the chamber.

7. The shoe of Claim 1 or 2, wherein the liquid composition comprises an amount of liquid having a liquid density and an amount of particulate having a particulate density, wherein the particulate density is less than the liquid density.

8. The shoe of any preceding claim, wherein the liquid is a gel.

9. The shoe of any preceding claim, wherein the shoe comprises a heel strike cushioning element, a medial motion control cushioning element and a forefoot cushioning element.

10. The shoe of any preceding claim, wherein the cushioning element is a heel strike cushioning element and wherein the cushioning element has a flexure joint along a portion of the element.

11. The shoe of Claim 10, wherein the flexure joint is a partition for directing flow of liquid from one portion of the chamber to another portion of the chamber.

12. The shoe of any of Claims 1 to 9, wherein the cushioning element is a forefoot cushioning element and wherein the cushioning element has a flexure joint along a portion of the element.

13. The shoe of Claim 12, wherein the flexure joint is a partition for directing flow of liquid from one portion of the chamber to another portion of the chamber.

14. A shoe comprising:

a sole portion having peripheral edges;

a heel strike cushioning element comprising a chamber having flexible walls filled with a liquid composition, wherein the chamber includes a plurality of partitions for directing flow of liquid from one portion of the chamber to another portion of the chamber, wherein at least one partition is a gating means responsive to a differential in liquid pressure for enabling the flow of liquid to the chamber portion of lower liquid pressure,

the cushioning element overlying the sole portion, a portion of the element extending to a peripheral edge to provide cushioning support to a foot of a wearer at the peripheral edge, the extending portion of the element having susbtantially transparent walls, whereby the liquid composition can be viewed from the exterior of the shoe through the substantially transparent walls, wherein the liquid composition comprises an amount of a gel having a gel density and an amount of particulate having a particulate density, wherein the particulate density is less than the gel density,

wherein the cushioning element has a flexure joint along a portion of the element, which is a partition for directing flow of liquid from one portion of the chamber to another portion of the chamber.

15. A shoe comprising:

a sole portion having peripheral edges;

a forefoot cushioning element comprising a chamber having flexible walls filled with a liquid composition, wherein the chamber includes a plurality of partitions for directing flow from one portion of the chamber to another portion of the chamber,

the cushioning element overlying the sole portion, a portion of the element extending to a peripheral edge to provide cushioning support to a foot of a wearer at the peripheral edge, the extending portion of the element having substantially transparent walls, whereby the liquid composition can be viewed from the exterior of the shoe through the subtantially transparent walls,

wherein the liquid composition comprises an amount of a gel having a gel density and an amount of particulate having a particulate density, wherein the particulate density is less than the gel density,

wherein the cushioning element has a flexure joint along a portion of the element, which is a partition for directing flow of liquid from one portion of the chamber to another portion of the chamber.

16. A cushioning element for a shoe sole comprising a chamber having flexible walls filled with a liquid composition,

wherein the chamber includes a plurality of partitions for directing flow from one portion of the chamber to another,

wherein at least one partition is a gating means responsive to a differential in liquid pressure for enabling the flow of liquid to the chamber portion of lower liquid pressure.

17. A cushioning element for a shoe sole comprising a chamber having flexible walls filled with a liquid composition, wherein the liquid composition comprises an amount of a liquid having a liquid density and an amount of particulate having a particulate density, wherein the particulate density is less than the liquid density,

wherein the chamber includes a plurality of partitions for directing flow from one portion of the chamber to another.

18. The cushioning element of Claim 16 or 17, wherein the liquid is a gel.

19. The cushioning element of Claim 17, wherein at least one partition is a gating means responsive to a differential in liquid pressure for enabling the flow of liquid to the chamber portion of lower liquid pressure.

20. The cushioning element of Claims 16 or 19, wherein the gating means is a flexible member extending from the chamber wall into the chamber.

21. The cushion of Claim 16, wherein the liquid composition comprises an amount of a liquid having a liquid density and an amount of particulate having a particulate density, wherein the particulate density is less than the liquid density.

22. The cushion of Claim 16, wherein the chamber is filled with a gel composition comprising an amount of a gel having a gel density and an amount of particulate having a particulate density, wherein the particulate density is less than the liquid density.

23. A forefoot cushioning element for a shoe sole comprising a chamber having flexible substantially-transparent walls filled with a liquid composition, the chamber including a plurality of partitions for directing flow of liquid from one portion of the chamber to another portion of the chamber,

wherein the liquid composition comprises an amount of a gel having a gel density and an amount of particulate having a particulate density, wherein the particulate density is less than the gel density,

wherein the cushioning element has a flexure joint along a portion of the element which is a partition for directing flow of liquid from one portion of the chamber to another portion of the chamber.

24. A heel strike cushioning element for a shoe sole comprising a chamber having flexible substantially-transparent walls filled with a liquid composition, wherein the chamber includes a plurality of partitions for directing flow from one portion of the chamber to another portion of the chamber, wherein at least one partition is a gating means responsive to a differential in liquid pressure for enabling the flow of liquid to the chamber portion of lower liquid pressure,

wherein the liquid composition can be viewed through the substantially transparent walls,

wherein the liquid composition comprises an amount of a gel having a gel density and an amount of particulate having a particulate density, wherein the particulate density is less than the gel density,

wherein the cushioning element has a flexure joint along a portion of the element which is a partition for directing flow of liquid from one portion of the chamber to another portion of the chamber.

25. A cushioning element for a shoe sole comprising:

a chamber having side walls and top and bottom walls, the walls being flexible and transparent;

downwardly-depending flexible partitions extending from the top wall of the chamber into the chamber, the partitions defined by sidewalls terminating at a downward edge;

a plurality of zones, defined by partitions or groups of partitions, within the chamber;

a liquid composition filling the chamber, the liquid composition being visible through the transparent walls of the chamber;

wherein, a force directed to the cushioning element creates a higher liquid pressure in one zone of the chamber and the partitions coact to direct the resulting liquid flow from the zone of higher liquid pressure to zones of the chamber of lower liquid pressure.

26. The cushioning element of Claim 25 wherein at least one partition is a gating means responsive to a differential in liquid pressure for enabling the flow of liquid to the chamber portion of lower liquid pressure.

27. The cushioning element of Claim 26 further comprising a flexure joint defined by a downwardly depending projection from the top wall of the chamber into the chamber, the flexure joint formed of sidewalls terminating in a downward end, the flexure joint depending into the chamber a distance greater than the partitions and extending along the chamber a distance greater than the partitions, to provided flexibility to the cushioning element as well as to coact with the partitions to direct the flow of liquid from one zone of the chamber to another.

28. The cushioning element of Claims 27 further comprising a raised ridge extending into the chamber from the bottom wall of the chamber, the ridge terminating in a generally planer upper surface, the ridge positioned within the chamber to correspond to the flexure joint such that when a sufficiently large force is exerted upon the cushioning element and the flexure joint is forced downward within the chamber, the downward end of the flexure joint will contact the upper surface of the ridge and the sidewalls of the flexure joint will pro-

vide structural stability to the cushioning element.

29. The cushioning element of Claims 23 or 25 further comprising contouring partitions defined by channels formed corresponding areas of the top and bottom walls and sharing base portions, the contouring partitions coacting with the partitions to direct the flow of liquid by preventing the flow of liquid therethrough, the contouring partitions providing increased flexibility to the cushioning element.

30. The cushioning element of Claims 25, 26, 27, or 28 wherein the liquid composition comprises an amount of a liquid having a liquid density and an amount of a particulate having a particulate density, wherein the particulate density is less than the liquid density.

31. The cushioning element of Claims 25, 26, 27, or 28 wherein the liquid is a gel.

FIG-1

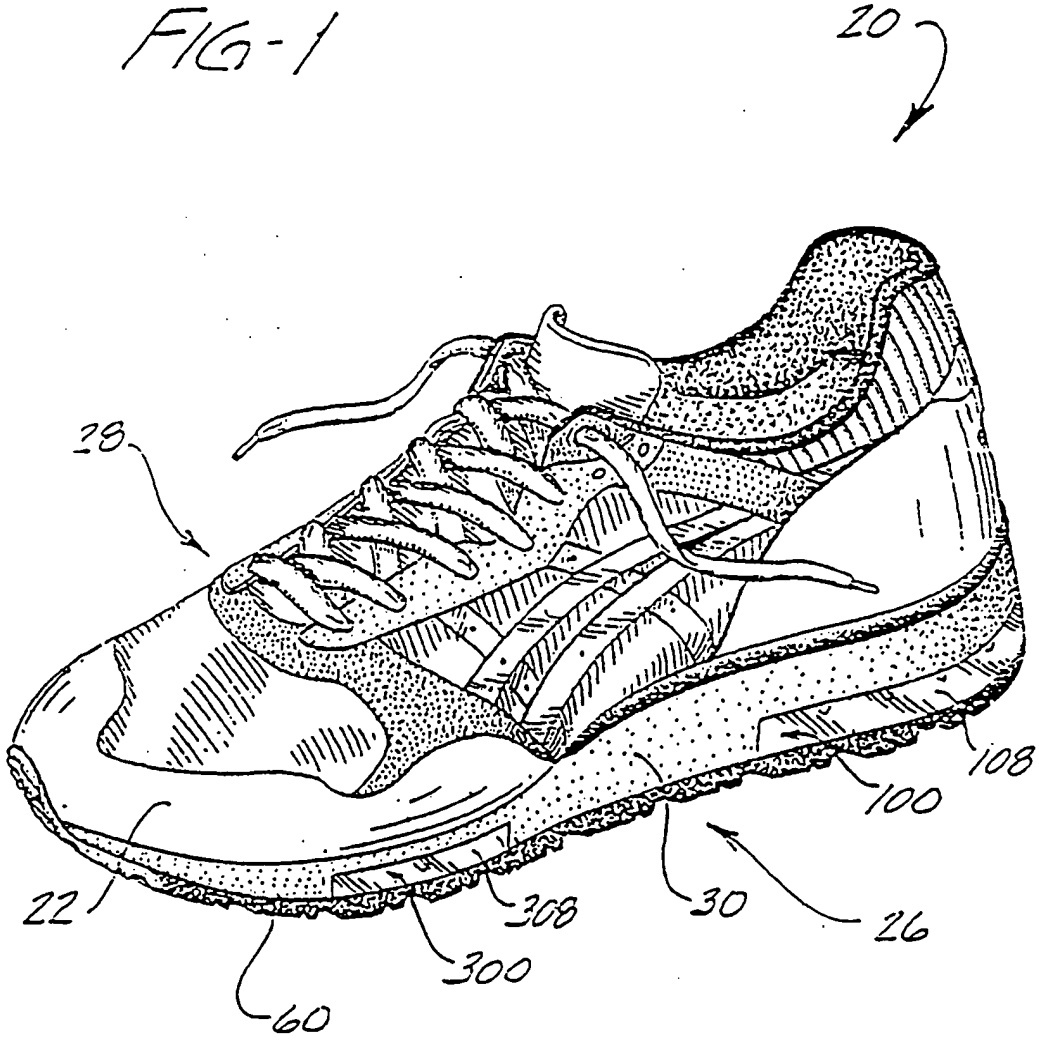

FIG 2

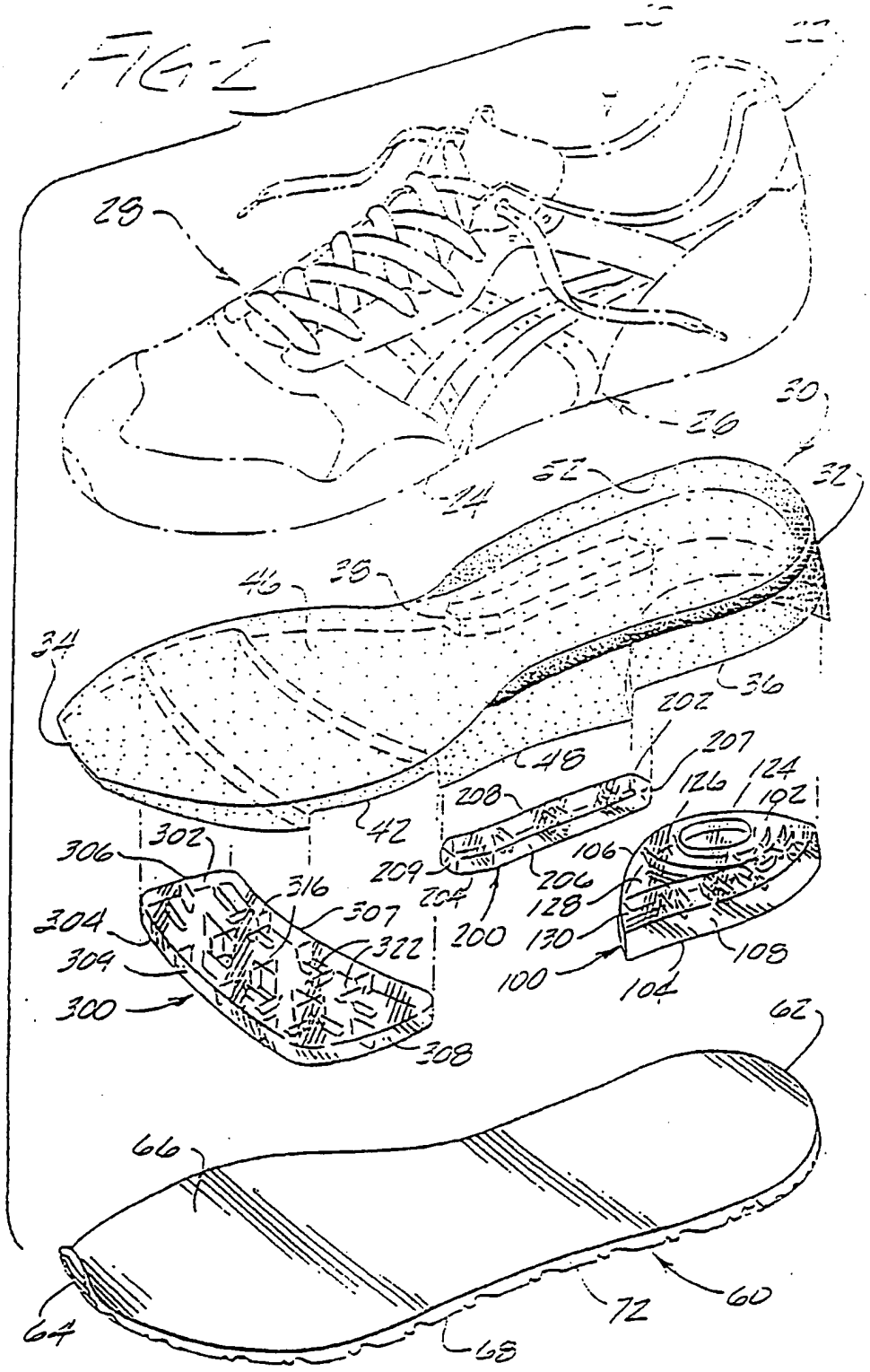
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FIG-3

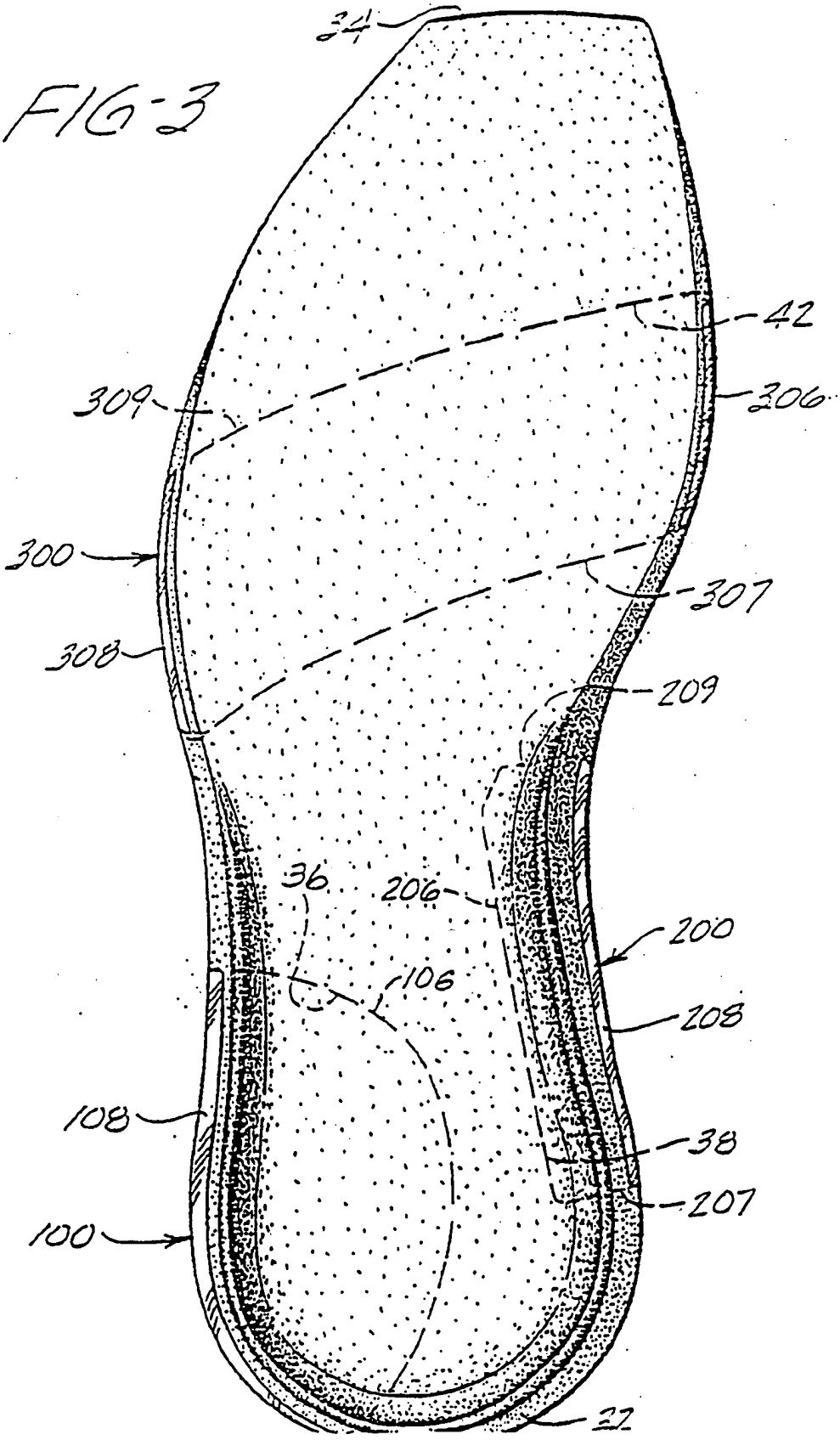


FIG-4

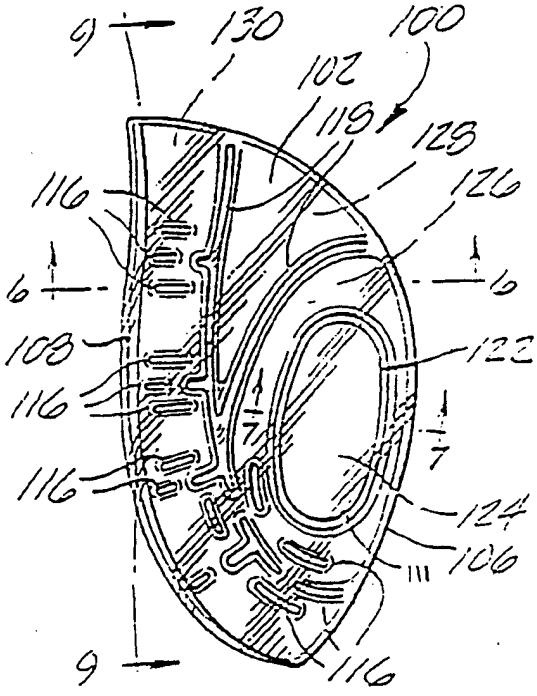
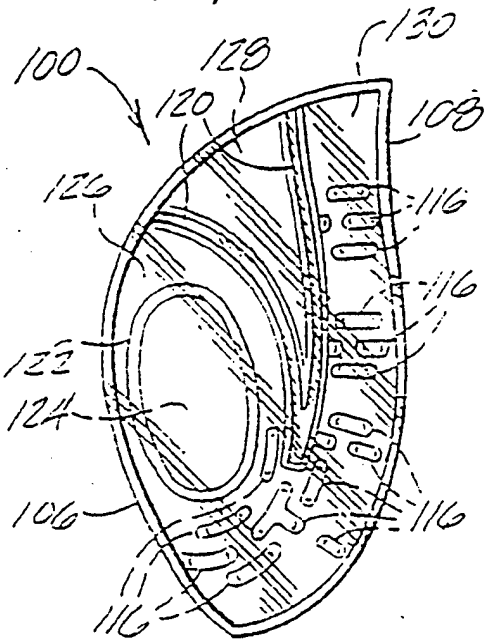


FIG-5



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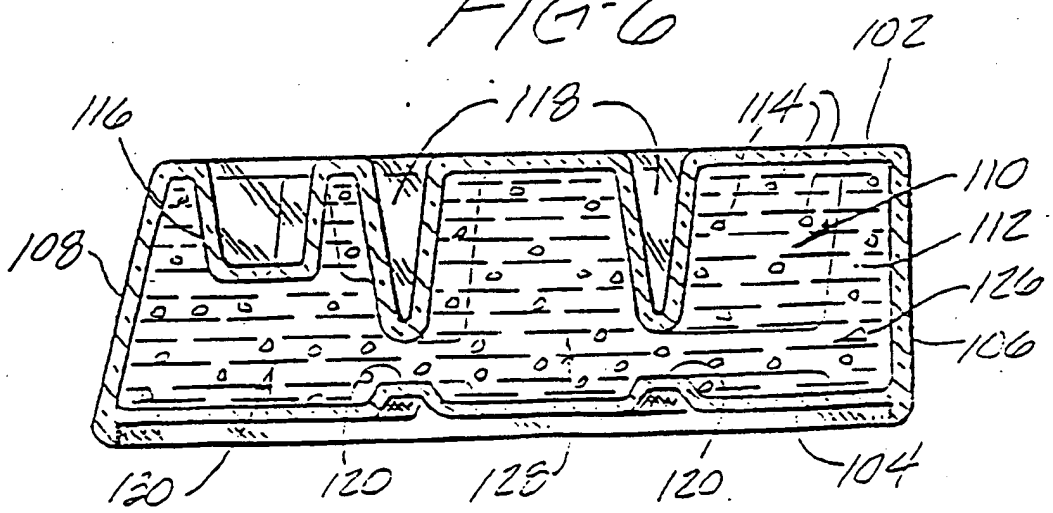

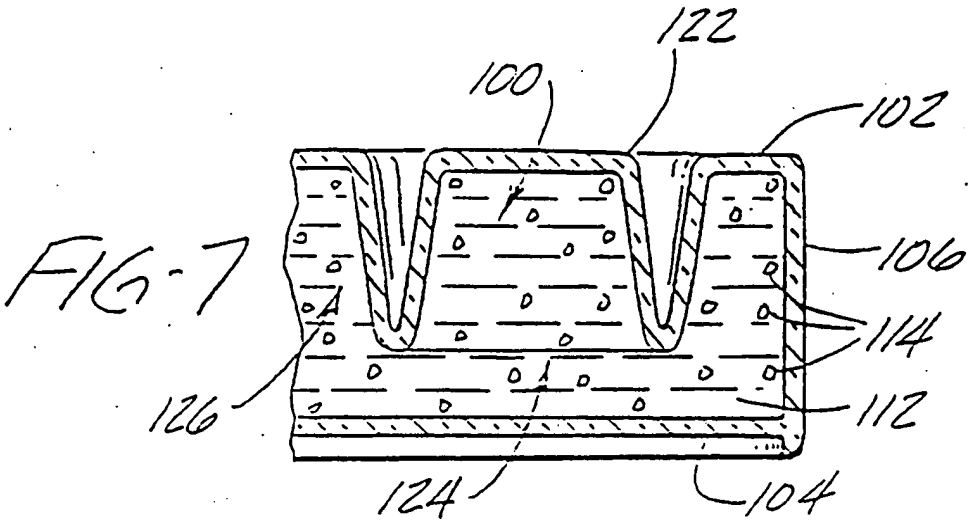

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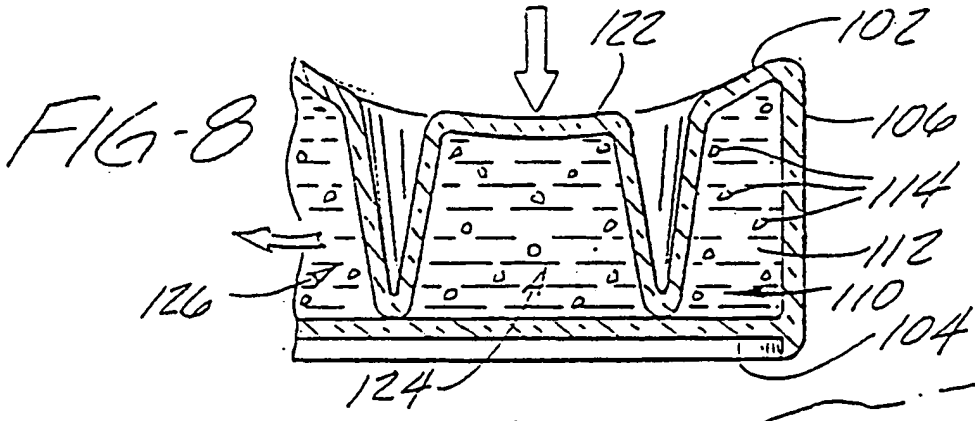

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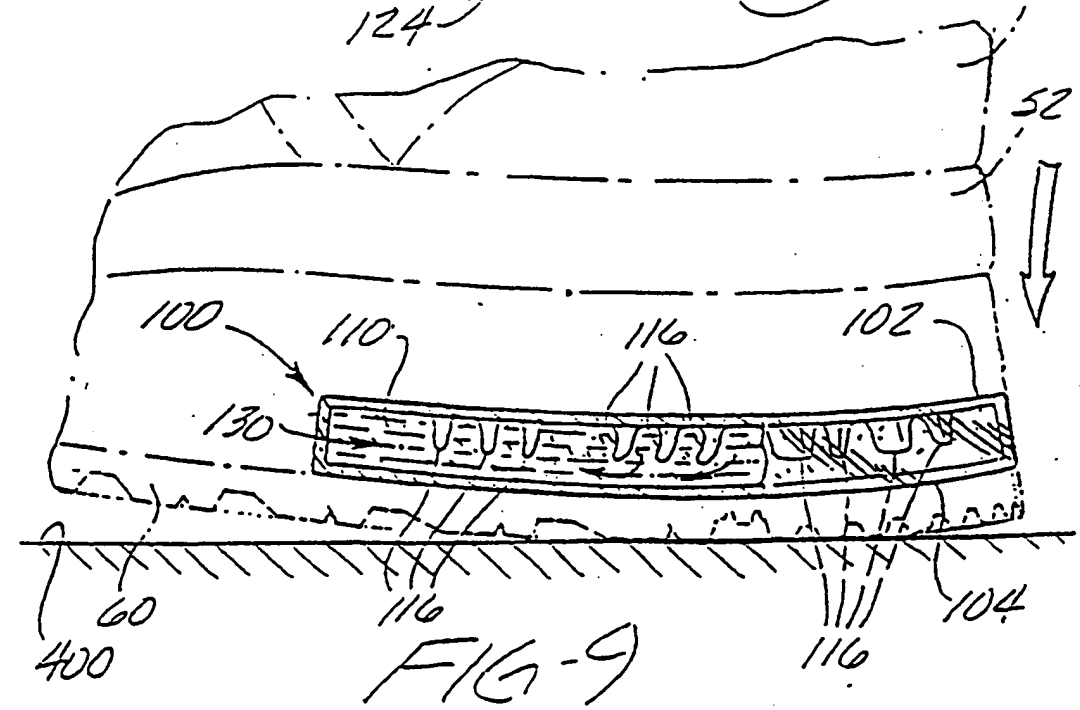
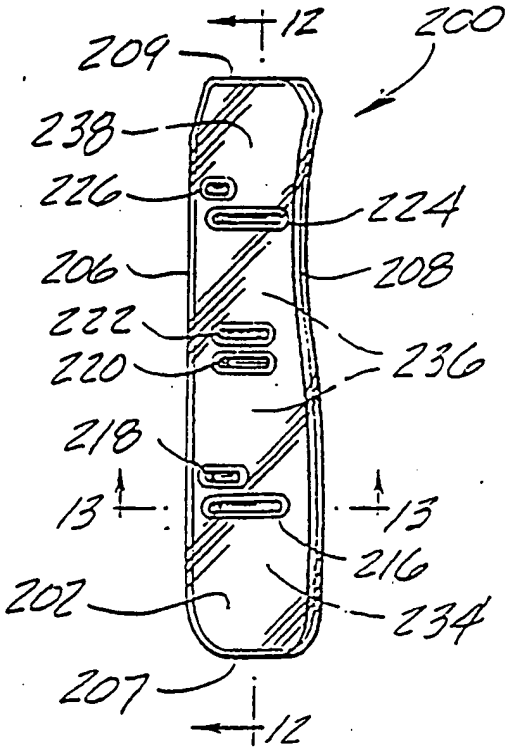


FIG-9

FIG-10



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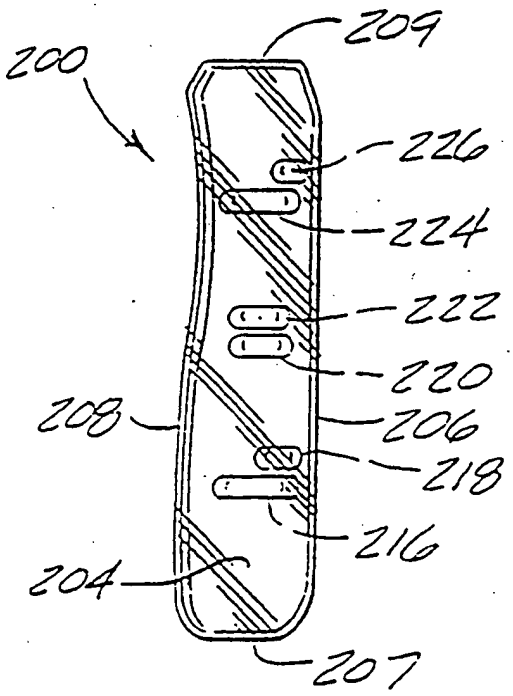


FIG-12

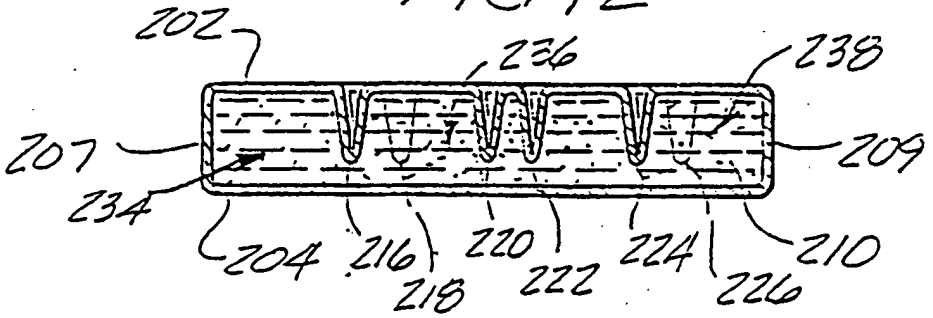
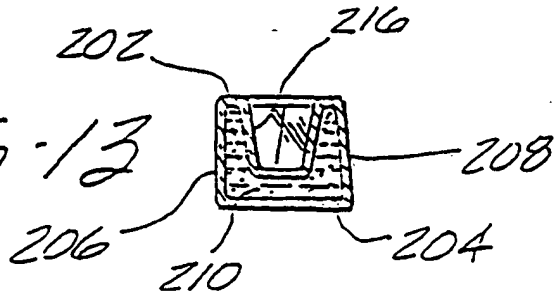


FIG-13



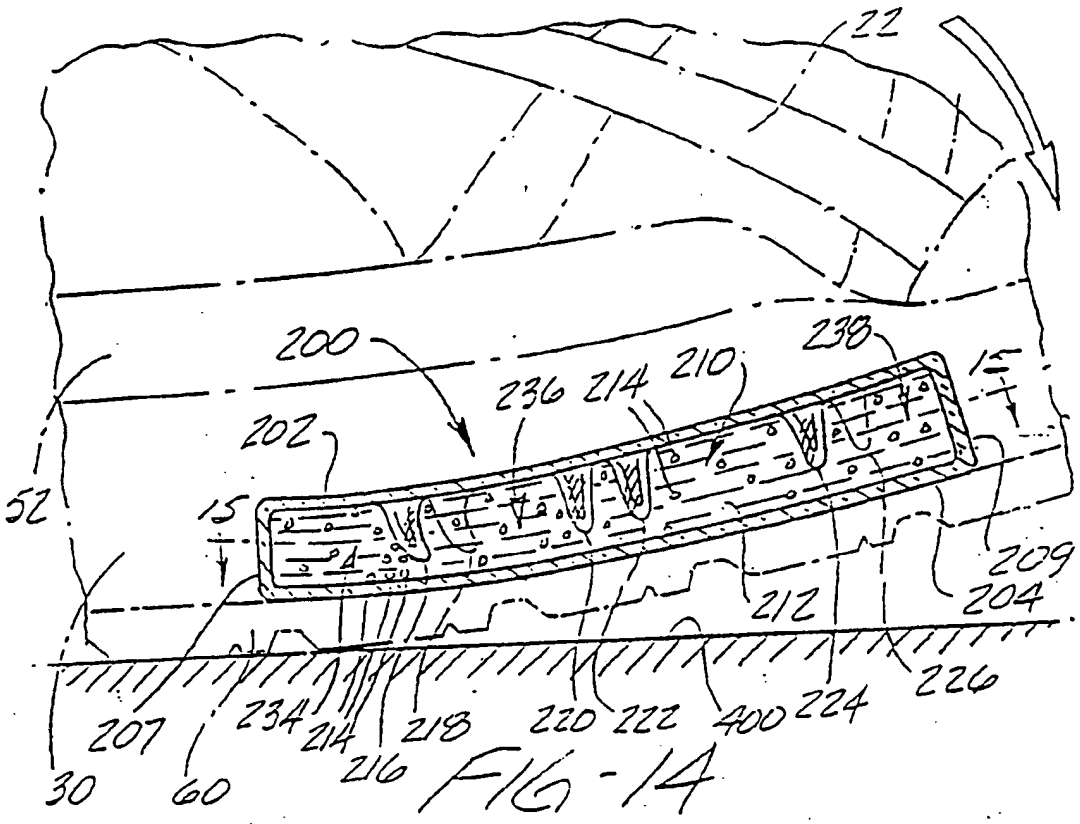

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FIG-14

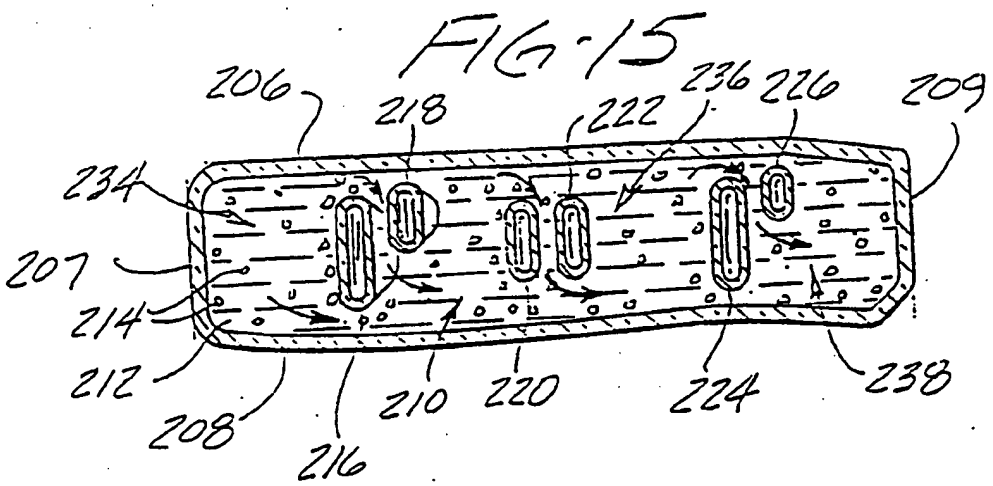
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FIG-15

FIG-16

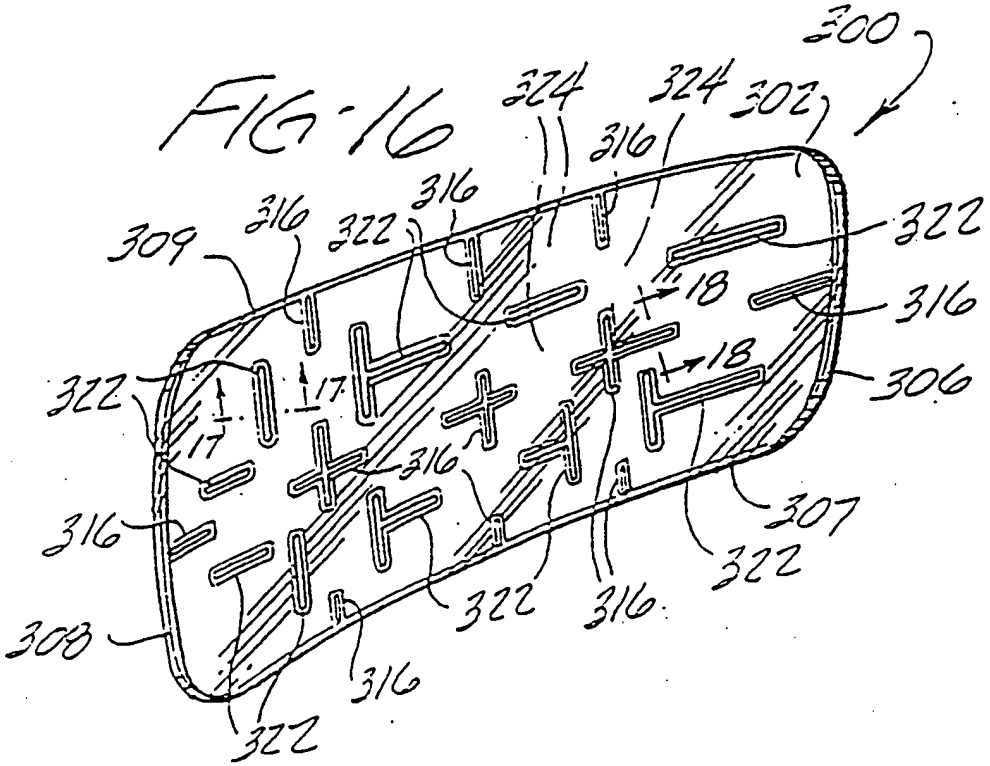


FIG-17

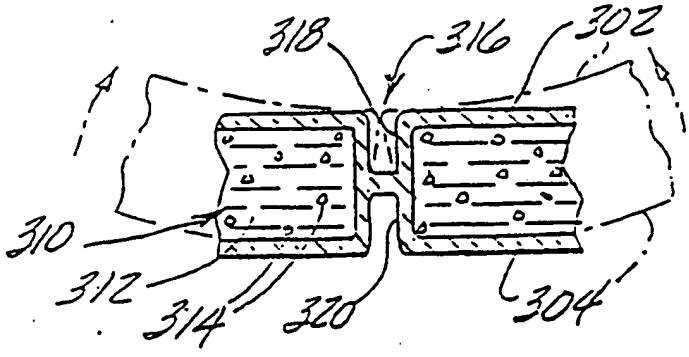
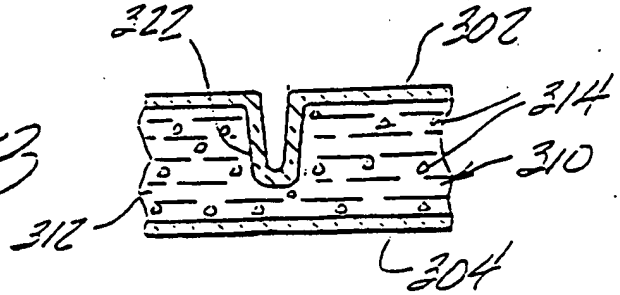


FIG-18



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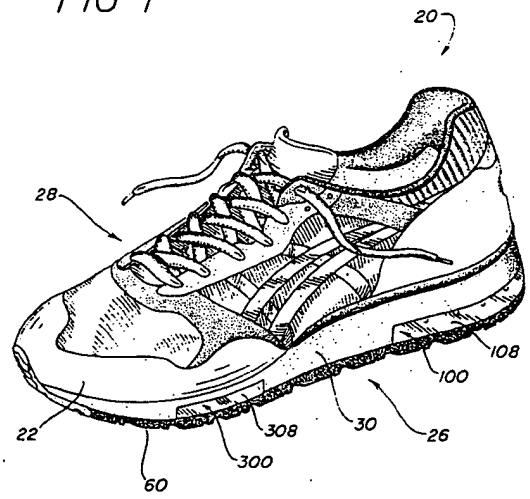
(54) A shoe.

(57) A shoe (20) comprising a sole portion (30,60) having peripheral edges and at least one cushioning element (100,200,300) comprising a chamber having flexible walls (106,108,206,208) filled with a liquid composition (110,210,310), wherein the chamber includes a plurality of partitions for directing flow of liquid (110,210,310) from one portion of the chamber to another portion of the chamber. Preferably, at least one partition is a gating means responsive to a differential in liquid pressure for enabling the flow of liquid to the chamber portion of lower liquid pressure. The cushioning element (110,200,300) overlays the sole portion (30,60). A portion of the cushioning element extends to a peripheral edge to provide cushioning support to a foot of a wearer at the peripheral edge. Preferably, the extending portion of the element (100,200,300) has substantially transparent walls (106,108,206,208) whereby the liquid composition can be viewed. Preferably, the liquid composition comprises an amount of a gel having a gel density and an amount of particulate density is less than the gel density. Preferably, the cushioning element (100,200,300) has a flexure joint (118) along a portion of the element, which is a partition for directing flow of liquid from one portion of the chamber to another portion of the chamber.

FIG-1



EP 0 500 247 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 92 30 1093

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
D,A	US-A-4 817 314 (PARKER ET AL) * column 6, line 20 - line 34; figure 5 *	1-31	A43B13/20
P,A	EP-A-0 456 434 (NIKE INTERNATIONAL LTD) * column 9, line 3 - line 24; figures *	1-2	
A	EP-A-0 388 661 (AUTRY INDUSTRIES, INC) * the whole document *	1	
D,A	US-A-4 974 345 (YUNG-MAO) * column 4, line 56 - column 5, line 7; figures *	1	
A	DE-U-8 807 671 (KILLTEC SPORT UND FREIZEIT GMBH) * claim 1; figure *	1	
D,A	US-A-3 765 422 (SMITH) * column 1, line 52 - line 57 * * column 2, line 13 - line 19; figures *	3-31	
A	US-A-4 255 202 (SWAN, JR.) * abstract; figures *	3	TECHNICAL FIELDS SEARCHED (Int. Cl.5) A43B
D,A	US-A-4 567 677 (ZONA) * column 2, line 40 - line 54; figures *	3-31	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 JUNE 1993	SCHÖLVINCK T.S.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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